HAWKER SIDDELEY

DRANETZ

User's Guide for SERIES 808 ELECTRIC POWER/DEMAND ANALYZER

Voltage Cable For Dranetz 808

A QUICK REFERENCE GUIDE TO THE MOST FREQUENTLY USED INFORMATION

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*Setup procedures for Two-Wire Circuits are identical to these for Three-Wire Circuits except that only a one channel measurement is required in Step 2 on page 35.

A Note to the Reader:

We have taken every effort to answer all of your questions in this User's Guide. However, if after looking through this Guide you find you still need more information, you can talk to our factory engineers who will always help you. Just call us at (201) 287-3680 and ask for technical assistance on the 808.

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ORANETZ
SERIES 808 ELECTRIC POWER/DEMAND ANALYZER
READ
PRINT
SET
CLEAR
VOLTS
AMPS
WATTS
V.A
P.F.
V.AR
CHAN A
CHAN B
CHAN C
FEED
ENTER

INTRODUCTION TO AND GENERAL DESCRIPTION OF THE 808

The 808 Electric Power/Demand Analyzer is a state-of-the-art, microprocessor-controlled electric power and demand measuring, indicating and recording instrument — providing all of the measurements, calculations, analysis and accuracy required to quickly, easily, and conveniently make power surveys, perform equipment tests and for continuous demand (KW, KVA, KVAR)*, and energy (KWH) monitoring and recording. Since data are presented by the 808 in alphanumeric format via in-line display or thermal column printer, no longer is it necessary to struggle with the sometimes lengthy charts of conventional graphical recording instruments and the attendant difficulties of hunting for peaks and valleys with the potential for incorrect interpretation of analog values.

This instrument can be used with single-phase, split-phase, and polyphase AC power configurations over a wide range of analog voltages and currents (including non-sinusoidal waveforms), with appropriate input devices such as current transformers (CT's) and potential transformers (PT's). Input voltage leads from the instrument can be connected to circuits of up to 600 volts RMS. External voltage transformers can be used to extend the range. Moreover, a known voltage or assumed voltage value and PF may be set into the 808 memory by the user via the keypad, when voltage connections are inconvenient or where accuracy is not critical.

*NOTE: *On some original 808 software, the only unit of continuous demand is KW.*

The 808 is designed to measure, display and record *true RMS* load power quantities associated with electrical circuits. It determines real or active power (Watts), reactive power (VAR), apparent power (VA), and power factor (PF), as well as voltages and currents for single, two and three-phase electric power circuits.

The 808 can also accept pulses from watthour meters, demand meters, and other pulse initiating devices for computation of demand and energy consumption, such as demand interval synchronizing pulses where the utility makes such pulses available. When used with a pulse type input, the 808 is limited to display and printing of energy (KWH), energy rate (KWMIN), and demand data consisting of watts (KW), demand (Dm), predicted or projected demand (PDm), accumulated demand (Dm) and printing of a demand summary. There is also provision for setting demand and energy rate limits which, when exceeded, print out and activate an audible alarm. Optional relay contact alarm outputs are available which close when these limits are exceeded.

Setup and programming are accomplished through the user-friendly keypad. Setup is simplified by the "MODE" and "FUNCTION" lamps located below the display, and by displayed programming guidance statements.

When the 808 front panel KEYSWITCH is initially turned from OFF to OPER or SETUP position, the 808 turns on automatically, preset to measure three channels of voltage and three channels of current using three Dranetz Clamp-on

Current Transformers (CT), Model TR-2012. These preset values of setup instructions are called the "default" setups. Preset or default setups, and other setups, can be changed at any time by the operator through the front panel keys to suit the application. This is accomplished by either following the automatically sequencing displays of the SETUP DATA routine (see page 53) which immediately follows the 808's automatic printing of the words "Power On," or at any time by using the SET Mode and SETUP DATA keys.

The 808 can be used as either a permanently installed monitor or as a test instrument connected for relatively short periods of time. Permanent installation would probably be at the electrical service entrance to a plant or at major substations inside the plant. It is at these critical locations where it is important to make sure demand, energy consumption, and power factor do not get out of hand.

To survey the internal electric system, the 808 is used as a portable test instrument, normally connected at each location for a full operating cycle only (a day, a week, or possibly a month), or perhaps for very short periods if simply checking the power factor of an individual motor.

All 808 "Power On" printouts which appear when the KEY-SWITCH is turned from OFF to OPER or SETUP include a preset date. The "Power On" date indicates the software revision level as of the date of manufacture. This document is written to the 20-OCT-81 level. Examples of other "Power On" dates are 10-SEPT-81, 11-SEPT-81, 12-SEPT-81.

The two principal forms of 808 printer output are the "Demand Summary" and "Status" formats. Each printed tape starts with the date and time down to seconds at which the printout was made, providing the internal clock and calendar have been properly set. An internal battery permits time and other program information to be retained so that the instrument does not have to be set up each time it is moved from location to location.

The Demand Summary tape indicates the four highest demand intervals of the day, the four highest demand intervals of the month, daily energy use, month-to-date energy use, and average power factor for each reading. Billing dates can be set in, if desired, and used instead of months. Normally this tape prints out at midnight and at three other selected times of day, but can be called for at any time upon operator command. The demand interval is determined by either an external synchronizing pulse, if available, or by programming it into the 808 and thus using the internal clock. Internally programmed demand intervals can be set between one** minute and 120 minute intervals, fixed; and 10 minutes to 60 minutes, sliding in five minute increments.

The Status tape indicates all present instantaneous values. Setup procedures permit printing out only those variables of prime interest and deleting those that are not necessary. Even full status printouts of four-wire circuits can be simplified. The Status tape can be programmed to print out at the same times as the Demand Sum-

---

NOTE: *On some original 808 software, the smallest fixed demand interval is* **five *minutes.*

mary tape, or can be called for at any time by operator command.

The Status tape can also be programmed to automatically print out after any demand interval during which the demand exceeded the operator-set limit. Thus, if the demand interval is set at 5 minutes and the demand limit to zero, the Status tape can be made to print out every 5 minutes.

Though not particularly suggested unless truly necessary, even more frequent Status printouts can be generated by setting up for external synchronization and delivering an external pulse at some interval less than 5 minutes, say every 2 minutes. With the 808 seeing a 2 minute demand interval and the demand limit exceeded, a Status tape will be printed every 2 minutes. With very frequent printouts, however, watch out for a "Paper Low" printout; this indicates that less than 20 feet of print paper remains. Communications Interface Option 104 (see REMOTE FUNCTION, page 20) would save printer paper if very frequent Status reports are required.

Not only can the demand limit be set, but also a percentage of the demand limit from 10 to 90 percent in 10-percent increments. Thus, if set at 80 percent and the demand exceeds 80 percent of the limit, at the end of the interval the 808 will print out the demand and the indication that it exceeds 80 percent of the set limit. In a similar manner there is a settable limit on energy rate in watts per minute. If exceeded, the rate will print out.

Also available by specific keys are the demand accumulation for the present interval together with the number of minutes into the interval, the energy rate for the past minute in watts per minute, and the projected demand at the end of an interval and the number of minutes into the interval (assuming no change in average demand rate to the end of the interval).

When pulse inputs from a revenue meter are used, no power connections are made and all information is input via pulse train. Under this condition outputs are limited to demand, energy rate, and energy consumption related variables.

Accuracy of measurement will be the sum of the accuracies of the 808, plus the accuracy of current transformers (CT's) plus Isolated CT Terminations for current (if used), plus potential transformers (PT's) (if used). See the looseleaf 808 Operator's Manual for accuracies of the 808 and its accessories.

CAUTION

This instrument is designed for proper operation on a flat surface on its large rubber feet, or tilted upward on the bale handle only. Operation of the 808 resting on the small rubber bumpers on the back of the unit will cause the paper take-up mechanism to malfunction.

WARNING

Because of shock or fire hazards, connection to this instrument should be performed in compliance with the National Electrical Code (ANSI CI) and/or any other requirements which may be applicable to the user. Installation, operation, and maintenance should be performed only by qualified personnel.

SAFETY PROCEDURES

Do not attempt to measure current in any circuit in which the voltage to ground exceeds the insulation rating of the CT.

Before each use, inspect CT's for cracks, breaks or crazes in the insulation. Replace immediately if defective.

Hands, shoes and floor must be dry when installing clamp-on CT's on a power line.

Make sure the jaws of the clamp-on CT are tightly closed. Keep mating surfaces clean and free from foreign matter.

BATTERY NOTE

The 808 has been designed to operate using a 120 volt power line (230 volts for Model 808A). The power cord actually operates a small charger that *constantly* charges the 808's internal battery — which is *part of the 808's electrical power system,* not only a back-up in the event of power line failure. It is *the battery* which operates the 808, not the 120 volt power line; this is a most capable way of eliminating the effect of power line disturbances, transients and noise on the proper operation of the 808, as well as providing for a limited supply of standby power if needed.

If the "Charger < Lim" printout or display occurs (the 808 will sound audible beeps about every eight seconds as well), this indicates that the 808 detects a loss of input power to itself; check to be sure that the input power cord is plugged in. Unless input power is restored, the 808 will continue to run strictly on the present strength of its own internal battery for about 15 minutes, and then will place itself into Standby mode.

Since the battery charge level is critical to the proper operation of the 808, it is highly recommended that when the unit is not in use, the 808 be switched OFF and kept plugged into the power line to maintain the battery charge. Keep the 808 out of service by placing its KEYSWITCH in the OFF position and the power line plugged in overnight (about 12—15 hours) before reusing the 808.

THE THREE BASIC METHODS OF MEASUREMENT USING THE 808

1. Analog Measurement Of Both Voltages And Currents

(a) Below 600 V RMS

- Use direct connections to electrical circuit to measure voltages with Dranetz voltage cable P/N 110,686 supplied with unit.
- Use Dranetz CT's TR-2012 or TR-2013 plugged into current connector receptacles J2, J3, and J4 to provide full scale ranges of 10 A RMS to 1000 A RMS. For 2000 A RMS to 3000 A RMS full scale ranges use Dranetz TR-2015 with Isolated CT Termination P/N 110,635-G5.
- Use commercially available CT's with the Dranetz isolated CT Termination P/N 110,635-G1 for 1 Amp, and P/N 110,635-G5 for 5 Amp CT's.

(b) Above 600 V RMS

- Use properly rated potential transformers (PT's) with nominal output of 115 V RMS secondaries (ANSI C57.13, Class 0.3) wired to the 808 with the Dranetz voltage cable P/N 110,686 supplied with the unit.
- Use commercially rated CT's with 1 A RMS or 5 A RMS Dranetz Isolated Terminations, P/N 110,635-G1 and P/N 110,635-G5, respectively.

2. Analog Measurement of Current Using an Assumed Voltage and PF

(a) Use CT connections as in 1(a).

(b) Enter known or assumed voltage and PF. (See pages 55—56.)

3. Using Only Pulse Type Inputs

(See pages 45—47 for connecting the 808)

Use only pulses from a pulse initiating device such as watthour meter. No analog measurements can be made when using pulse inputs.

Data available from the 808 when using pulse inputs will consist of all the energy and demand related readouts and printouts.

NOTE:

The 808 will always have at zero input current, a residual reading which is specified to be no greater than 0.1% of full scale (0.01 A for k FACTOR = 1). These residuals are caused by DC offsets and noise components in the 808's input amplifier circuits. The contribution of these components to instrument error is negligible.

THE FRONT PANEL OF THE 808

The front panel KEYSWITCH and touch sensitive keypad provide access to 808 functions and operations. They provide control of the 808 and a means to enter user requests for readouts and printouts, and for inserting into 808 memory such variables as CT and PT ratios, billing dates, print times, threshold settings for voltage, demand limits and energy rate limits. Also, date and time, number of channels to be measured, demand interval, lock code, and more. More on all of these setups later.

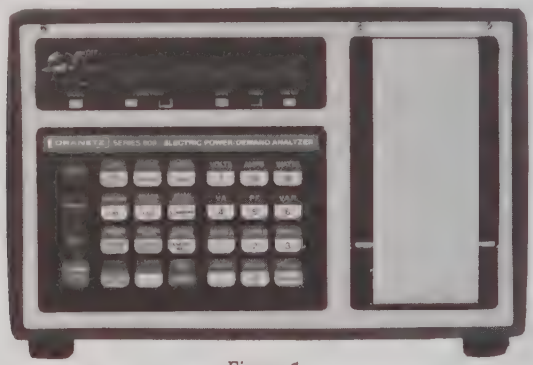


Figure 1.

All operational commands (setups) instructed to the 808 by the user are made in a simple CLEAR-MODE-FUNCTION touch key sequence (to be discussed later). For example: To read the value of power on Channel A, the key sequence is:

Moreover, after each touch of the key, the 808 will indicate the color of the keypad area whose key is to be selected *next*.

After the user touches the keys in this sequence (and hears a "beep" after each keystroke), the display will continuously indicate Channel A watts. If total power were desired instead of only Channel A,

would be substituted for

In the same manner, V, A, VAR, PF or VA may be substituted for watts in the example.

Each keystroke is annunciated with a single"beep." All incorrect keystrokes are followed by one second of several audible beeps, and !!Select Error!! will be flashed on the display.

THE KEYSWITCH: OFF, OPER, SETUP

The three-position, locking KEYSWITCH controls power to the 808 and access to setups.

- All 808 setups are made in the SETUP switch position.
- In the OPER switch position, setups *cannot* be altered, but otherwise the keypad is fully operational. (Use LOCK (red function touch key) to inhibit all keypad operations in the OPER keyswitch position. See description of LOCK on page 18.)
- OPER is the only position in which the key to the KEYSWITCH can be removed.
- KEYSWITCH to be OFF to recharge internal battery while the 808 is plugged into power line but not being used. *It is good practice to keep the 808 plugged in and the KEYSWITCH in the OFF position when not in use, as this will insure long life and proper function of the internal battery.*

THE PRINTER

The thermal-type matrix printer with automatic take-up reel for the 140 foot paper roll, contains sufficient capacity for up to several months of printouts. Roll life is dependent on frequency and number of lines of printout requested.

THE DISPLAY PANEL

A liquid crystal display provides single line readouts. All one-line outputs may be read on the display. The multiple line data outputs of the yellow function touch keys SUMMARY and STATUS cannot be displayed and are available only in printed format via the 808's matrix printer.

THE FRONT PANEL TOUCH KEYS AND THEIR USE

NOTE: Allow no more than 30 seconds to complete each touch key sequence. After 30 seconds, the 808 will return to its previous display.

The CLEAR Key

The blue CLEAR key is always the first key in the sequence of operational commands to the 808. It enables the 808 to recognize user requests for readouts, printouts, and setup changes.

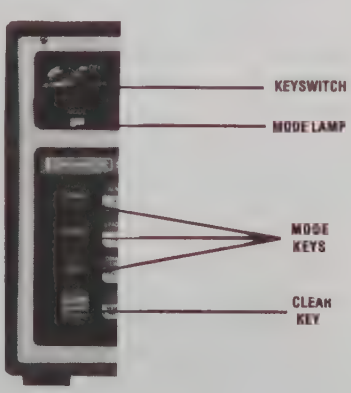


Figure 2.

The MODE Keys

The three green MODE keys provide access to measurements and stored demand data, and for altering setups or preset commands to the 808. When the green MODE lamp located above these keys is on, it is an indication to use a MODE key. This lamp will illuminate whenever the CLEAR key is pushed. To enable the 808 to accept requests for READ, PRINT or SET Modes, press one of the following:

Used in a key sequence to read a single line of data (READ MODE).

Used in a key sequence to print data via the 808's thermal printer (PRINT MODE).

Used in a key sequence to alter setups (SET MODE).

Examples:

Provides continuous display of Amps on Channel A.

Provides printout of STATUS.

The FUNCTION Keys

Each of the FUNCTION keys contains two colors and two descriptors. The red upper key half is accessed in a manner much like a "shift" is used on a typewriter keyboard. The "RED FUNCTION" is the "shift" key. Use the RED FUNCTION key before requesting a red key function in this keypad area. A red or yellow lamp above the FUNCTION keypad area when illuminated indicates which color of FUNCTION key may be used.

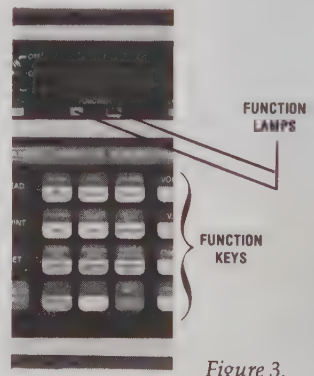


Figure 3.

For example, to read k FACTOR for volts, the proper sequence is:

Red FUNCTION Keys

(Use only when red lamp is on in this keypad area.)

Used for enabling the 808 audible alarm. ALARM provides a one second burst of beeps whenever 100% of the DEMAND LIMIT or an ENERGY RATE (KWmin) have exceeded set limits in a DEMAND INTERVAL:

A printout will occur whether or not the Alarm goes off, and will contain information on the ENERGY RATE exceeded, or on DEMAND LIMIT if 100% exceeded.

> **Option 101 — Alarm Relays**
>
> Two factory installed relays will activate external alarm devices. One relay is for a demand limit alarm, the other is for an energy rate alarm. Both relays are normally open; they will close for approximately one second when activated.

Used to maintain clock, calendar and setups when the 808 power cord is *not* plugged into an AC outlet:

"Standby On" with date and time appear on printer tape. Notice all lamps are off, display is blank, and keypad is now locked up. *The keys do not accept data or "beep" when pressed.* To exit this mode use the following sequence ("Standby Off" with date and time now appear on tape):

When the STANDBY function is set, KEYSWITCH should be left in OPER position during short term storage (no longer than two weeks) to maintain clock and setup data. Do not leave unit in STANDBY for extended storage periods, as this will deplete the battery.

DEMAND LIMIT

Use for setting a DEMAND LIMIT in KW, KVA or KVAR.* The 808 prints automatically at the end of a demand interval if measured demand exceeds the set limit. Audible ALARM and the STATUS printouts are optional setups. (Refer to STATUS, page 20.) Typical printout:

```
#Dm 197.6kW      .89PF
 02-Jun-82  15 45 54
```

This printout indicates that on June 2, 1982 at the time 15:45:54 (24-hour clock time, in hours, minutes and seconds), the demand at the end of the interval was 197.6 KW, which was above the set limit, with a power factor of .89.

The number symbol (#) in the printout indicates the measured demand was above the set DEMAND LIMIT (see % DEMAND LIMIT, STEPS 7 and 8 in SETUP DATA section, page 57.)

To set DEMAND LIMIT, for example: 335.95 KW.

Resulting display:

Dm W, VA or VAR	W

Select type or units of Demand. [The display shows that the 808 is currently using watts (W)]

(Note: earlier versions of the 808 provide watts only.)

Display changes to:

Dm Lim(k)	.00000

Now, set Dm to 335.95 KW:

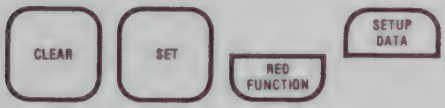
This setup is automatically followed by %Limit Print (STEP 8) and Rt Lim (kW) (STEP 9) in SETUP DATA pages 57 and 58.

---

*NOTE: *On some original 808 software, the only unit of demand is KW.*

Use SET Mode key to call up SETUP DATA function at any time to change setups or to confirm the 808's setup. To obtain a printout of setups in memory, use PRINT Mode instead of SET Mode in the following example.

To change SETUP DATA:



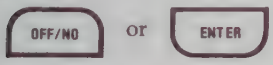
Allow no longer than the 30 seconds to subsequently make the changes. After 30 seconds the 808 display will revert back to its previous display. (For complete description of SETUP DATA sequences, see page 53.)

Usually a 15 or 30 minute metered period is used by electric utilities to detect the *highest average power in a period (Demand)* for billing purposes. The default setting for DEMAND INTERVAL is 15 minutes. DEMAND INTERVAL can be set between one minute* and 120 minute intervals, fixed; and 10 minutes to 60 minutes, sliding. Example: Set demand interval to 30 minutes, fixed, and do not stop 808 interval timing upon loss of measured power on all channels:

Step 1

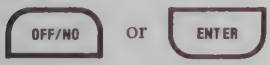
Sliding	No

Step 2



Stop on loss	No

Step 3



**NOTE: On some original 808 software, the smallest fixed demand interval is five minutes.*

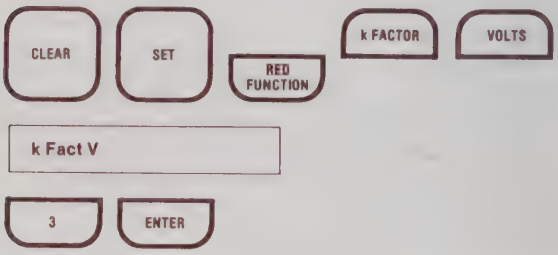
NOTE:

1. Unless all above steps are completed, the desired change of DEMAND INTERVAL to 30 minutes will not be accepted by the 808.
2. Sliding increment is always 5 minutes regardless of setting of sliding DEMAND INTERVAL between 10 minutes and 60 minutes.

User-set scale correction multiplier corresponding to the ratio of a transducer device such as a PT, CT or Isolated CT Termination. Provides for properly scaled displays and printouts. (One k FACTOR is allowed for all voltage inputs, and one k FACTOR is allowed for all current inputs.)

How to set a k FACTOR for Volts (applies to all voltage channels.)

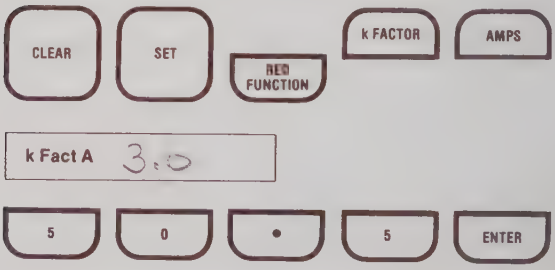
Example: Set k FACTOR for Volts to 3:



The 808 will now automatically multiply all voltage and power values by 3.

How to Set a k FACTOR for Amps (applies to all current channels.)

Example: Set k FACTOR for Amps to 50.5:



The 808 will now automatically multiply all current values by 50.5.

HOW TO CALCULATE k FACTOR FOR INPUT DEVICES SUCH AS PT'S AND CT'S

The k FACTORS for voltages and currents can be set in a range of 0.001 to 999999. A different k FACTOR can be used for voltages and currents, but the k FACTOR must be the same for all three phases.

The ratio of input to output (turns ratio) in decimal form is the k FACTOR for a particular CT or PT. For example, a current transformer (CT) has a turns ratio of 1000:5 (1000 Amps input produces a 5 Amp output), the k FACTOR is 1000:5, or 200. Setting the current k FACTOR to 200 will cause the 808 to multiply CT inputs by 200, thus enabling all displays and printouts to READ and PRINT scaled correctly.

TABLE I. k FACTORS OF DRANETZ ACCESSORIES

DRANETZ PART NO.	TYPE	k FACTOR (AMPS)
TR-2012	CT	1.00*
TR-2013	CT	3.00*
TR-2015	CT	200 (1000 A) 400 (2000 A) 600 (3000 A)
110,635-G5	Isolated CT	1.00
110,635-G1	Termination	0.20

*Same k FACTOR for both current switch ranges.

NOTE:

1. All CT's (and all PT's) require a k FACTOR setup (except those with a k FACTOR = 1).

Example: A PT, with 120 volts secondary, has an input of 2400 volts and an output of 120 volts (an input ratio of 20:1). The voltage k FACTOR is then 20.

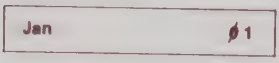
2. When both a Dranetz Isolated CT Termination and a CT are used in combination, the combined k FACTOR is the product of the two individual k FACTORs.

Example: A CT with a one Amp secondary has an input to output ratio of 250:1. The k FACTOR is 250. This CT, when used with the Dranetz Isolated CT Termination P/N 110,635-G1, will result in a correct combined k FACTOR of $250 \times 0.20 = 50$. In other words, $k_T = k_{CT} \times k_{Termination}$.

3. If direct voltage connections for the 808 are made (for circuit voltages up to 600 volts), the voltage k FACTOR equals 1 .

BILLING DATES

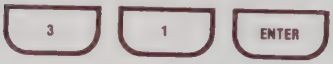
For setting, on a monthly basis for 12 months, January through December, in advance, billing dates of your local utility. (Default dates are the first of each month):



(The first of 12 displays appears.)

(Push ENTER if displayed data is to be retained.)

Example: Set Jan 31st:



Enter each month's billing date as desired for all 12 months. To skip a month press "O" and ENTER. To exit this prompted routine at any point, push CLEAR.

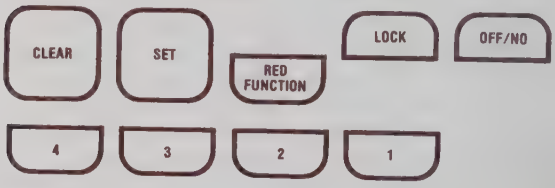
LOCK

Sets or removes software LOCK. Setting LOCK "ON" prevents unauthorized displays and printouts when the 808 is key-locked in the OPER switch position (for unattended 808 monitoring.) Automatic printing will not be affected.

To LOCK:

Key may now be removed from the KEYSWITCH. The last display request will continue to appear unless LOCK is removed and the setup changed.

To UNLOCK: (Locking key not required.)



Note:
4 3 2 1 is the default lock code. To change code, press CLEAR, SET, RED FUNCTION, SETUP DATA, your new four-digit code, and ENTER.

INTERVAL SYNC

Used in SET Mode to synchronize start of 808 demand interval timing with an external device such as a demand meter. This feature is used when synchronizing pulse is *not* available from a pulse initiating device.

Intv Sn	hh:mm:ss

(Will indicate time of day in hours, minutes, seconds using a 24-hour clock.)

To synchronize 808 to external device push: ENTER

at the instant the utility meter or other device visually or audibly begins a new interval.

PRINT HOLD

Used to inhibit printer operation while changing paper roll. Automatically cancels after approximately two minutes, or user can press CLEAR key to cancel. Paper feed not affected.

FEED

Paper Feed (Blue Half-Key): Advances the paper roll by providing several line feeds per keystroke.

Yellow FUNCTION Keys

(Use only when yellow FUNCTION lamp is on.)

DEMAND ACCUM

Use to display and print out accumulated demand in current demand interval.

Example:

Dm	156.7 KW	7

Printout or display indicates 156.7 KW has been consumed, after seven minutes into the demand interval.

ENERGY RATE

Use to display and print out watts (W) of energy used in last 808 measured minute. Audible alarm is programmable (See ALARM, page 13.)

Example:

Rt	75.61 KW min

DEMAND PROJECT

Use for display and printout (during an interval) of the demand projected by end of the interval with time (minutes) into the interval (assumes no change in energy rate for rest of interval). (Printout of PDm is optional with STATUS printout. See STATUS, page 23.)

Example:

PDm	159.60 KW	9

TIME

To READ, PRINT and SET TIME in "hhmmss" format (24-hour time clock in hours, minutes, seconds).

DATE

To READ, PRINT and SET DATE in "ddmmyy" (day, month, year) format.

RED FUNCTION

For accessing red or upper case keys in the FUNCTION keypad area. RED FUNCTION key always precedes the desired red key.

VALUE

This key always precedes selection of a unit of measurement (Volts, Amps, Watts, V.A., P.F., or V.A.R.) for instant display or printout.

Example: Read Watts for Channel C:

REMOTE FUNCTION

REMOTE FUNCTION key is available with options 105 and 106, 808 Communications Interface which provides digital outputs for remote recording, display or input to a computer. If you have ordered your 808 with this option, you will receive appropriate instructions for its proper use.

STATUS

Use for printing or changing the content of the STATUS printout. Any one or all of the following quantities in the STATUS printout are available for up to three channels (depending upon the circuit connections made): V, A, W, VA, PF, VAR, PDm. (STATUS is not available with pulse inputs.) Default STATUS printout is shown in Figure 5, page 21.)

NOTES:

1. A STATUS printout may be programmed to occur automatically with the SUMMARY. (See SUMMARY, page 25.)
2. A STATUS printout can be made available after each DEMAND INTERVAL whenever demand exceeds the DEMAND LIMIT setting. See SETUP DATA routine page 58, STEP 10.

3. When 808 is set for one channel input, only CHAN A STATUS will print (Figure 4). To print STATUS use STATUS key in the PRINT Mode.

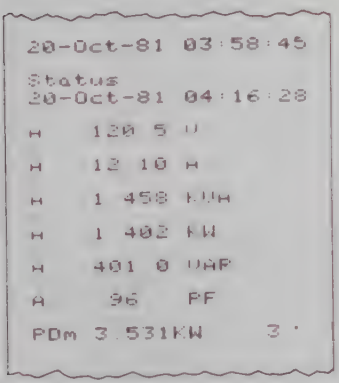


Figure 4.
STATUS printout when setup is for a single channel measurement (Channel A only). The number 3 to the right of the PDm value indicates the projected demand has been estimated at the end of the third minute of the demand interval.

4. In the *unlikely* event that STATUS printouts are required frequently — every 1 to 5 minutes* for a period exceeding one hour (which may be achieved by setting DEMAND LIMIT to zero and setting DEMAND INTERVAL to the desired printing interval in minutes) — the printer power drain could cause *depletion* of the 808 battery supply below that required to operate the 808. This can happen whether the 808 is plugged into a power line or not.

   In order to prevent battery power from depleting below a reliable operating level due to excessive printer operation, the 808 monitors printer use and when necessary, automatically switches to a slow print mode to allow the unit's charger to maintain the battery at a safe level. If printer switches to slow mode, avoid unnecessary printer use until battery charge returns to a safe level.

5. Sample Printouts.

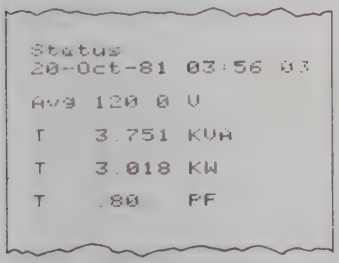


Figure 5.
Example of a Default Status Printout

*NOTE: On some original 808 software, the smallest fixed demand interval is **five** minutes.*

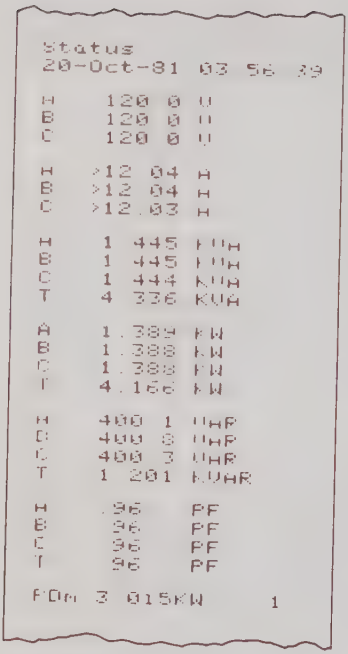


*Figure 6.**
Example of a full detailed STATUS printout for a three phase, four conductor hook-up. Note Amps are over the maximum 10.0 A RMS limit for the 808. A printout of this condition also will occur at time of overload of Volts or Amps (Figure 7).

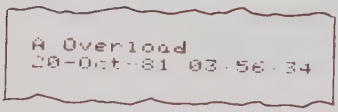


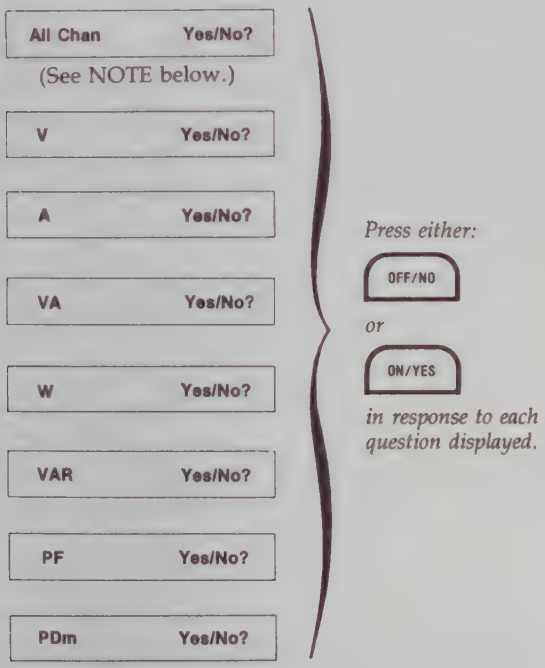
Figure 7.
Example of an Overload Printout (Amps)

*NOTE: On some original 808 software revisions, when the STATUS printout was requested by the user to reflect *all three channels* like this hook-up, *Total Amps* was included in this STATUS printout. Because of the confusion about the lack of usefulness of *Total Amps* here, it was dropped from subsequent software revisions.

Also, in some software revisions, for three-channel STATUS printouts, *Total Volts* was included, and was subsequently renamed *Average (Avg.) Volts* in later software to more accurately reflect its true description.

To Modify a STATUS Printout:

Sequential displays will then indicate all of the user's choices available for STATUS plus projected demand (PDm):



Here the 808 asks whether you wish to have projected demand indicated on the STATUS printout.

NOTE:
If All Chan *is answered "No," STATUS printout will be the average (Avg) for Volts; and the total (T) for KVA, KW, KVAR and PF (Amps will be deleted.) When the user answers "Yes" to* All Chan, *the STATUS printout will also indicate the individual A, KVA, KW, KVAR and PF for each channel.*

SUMMARY

SUMMARY prints the four highest demands (KW, KVA or KVAR*) of the day, and the four highest demands to date this month, or this billing period if not monthly. (See section on BILLING DATES, page 18.) Use the SUMMARY key to obtain an immediate printout of a Demand Summary from 808 memory:

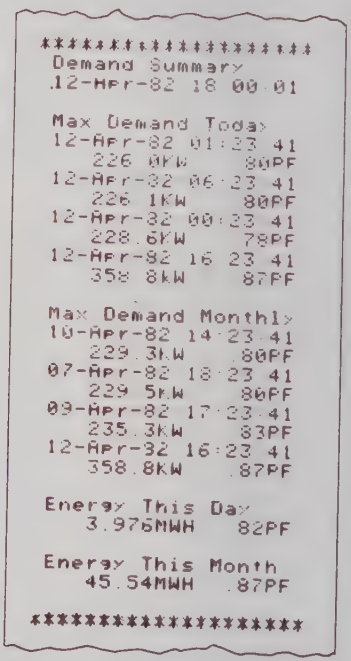
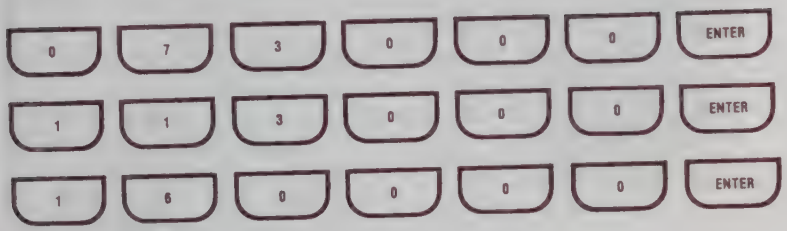


Figure 8. Sample SUMMARY Printout.

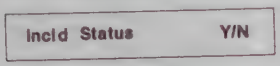
This SUMMARY printout indicates the date and time of the four highest demand intervals of the day, the four highest demand intervals of the month to date, daily energy use and month to date energy use (KWH), and the average PF for each period. An automatic SUMMARY printout occurs daily at midnight. This printout is not under user control. Three additional automatic SUMMARY printout times may be as desired, using a 24-hour clock system:

**NOTE: On some original 808 software, the only unit of demand is KW.*

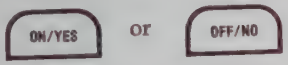
Examples: 1. 7:30 a.m.
2. 11:30 a.m.
3. 4:00 p.m.



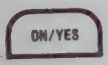
The next display will read:



Do you want automatic STATUS printouts with automatic SUMMARY printouts?

Press: 

Do you want to clear old accumulated demand data and energy to equal zero, or retain it in order to continue to accumulate?

Press: 

if you desire to *clear* stored SUMMARY data.

Or press:

to *retain* the already stored SUMMARY data.

UNIT, MISC and VALUE Keys:

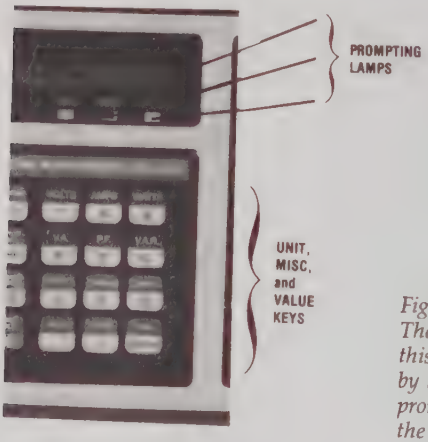
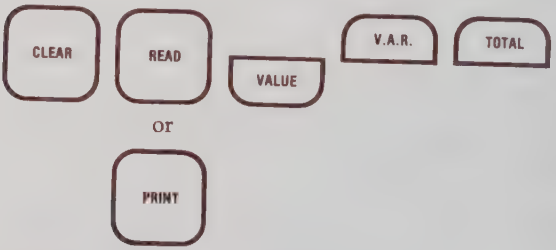


Figure 9.
The proper selection of keys in this keypad area is indicated by the green, red and yellow prompting lamps located just above the keys.

UNIT Keys:

UNIT keys are the green keys used to select readouts or printouts of the six individual electrical circuit parameters available from the 808, depending, of course, on the required circuit connections being made as recommended. UNIT keys are used when the green UNIT lamp is on. The parameters available are: VOLTS, AMPS, WATTS, VA, PF and VAR. To READ or PRINT one of the six available quantities, use the following sequence. Example is for reading or printing VAR for three phases of a four-wire power circuit:



NOTE:

For a single channel measurement, substitute the individual channel key such as CHAN A for the TOTAL key.

Scaling of Units

The 808 automatically applies appropriate scales to values, per the following:

808 PRINTOUT OR DISPLAY		UNIT RANGE
0.000 — 999.9		0.000 — 999.9
1.000 — 999.9	K ilo (thousand)	1.000×10^3 — 999.9×10^3
1.000 — 999.9	M ega (million)	1.000×10^6 — 999.9×10^6
1.000 — 999.9	G iga	1.000×10^9 — 999.9×10^9
1.000 — 999.9	T era	1.000×10^{12} — 999.9×10^{12}
1.000 — 9223	O (over 10^{15})	1.000×10^{15} — 9223×10^{15}

MISC Keys:

These are the red keys. They are used for selecting the channel to be displayed or printed, and for accepting or rejecting setups in the SETUP DATA routine (previously discussed on page 15.)

MISC keys are used when the red lamp is on above this key area.

These keys are used to select the individual channel of the 808 to be displayed or printed.

When the 808 is connected to an electrical circuit to measure both current and voltage (or an assumed voltage is used) any one of either VOLTS, AMPS, WATTS, VA, VAR, or PF (the UNIT keys) may be selected for readout or printout on a single channel basis.

For multiple channel printouts with one or more circuit parameters, see STATUS, page 23.)

Provides all three channels A, B, and C averaged or summed as appropriate. Available and appropriate for *total* WATTS, VA, VAR, and PF, or *average* Volts.

Examples of MISC Key use:

This results in a continuous display of CHAN A PF.

This results in a printout of average Volts of CHAN A, CHAN B and CHAN C.

Use to accept existing setups as they appear in the display.

Use to reject existing setups as they appear in the display.

VALUE Keys:

These yellow keys are indicated for use by the yellow lamp just above the keypad.

Enters keystroke data into 808 memory (some entries are automatic). Also ENTER may be used to accept displayed setups.

Numeric keys for setting up thresholds, k FACTOR and other numeric inputs.

Decimal point key.

TABLE II —
LEGAL READ, PRINT AND SET MODE KEY REQUESTS

KEY	MODE		
	READ	PRINT	SET
ALARM			X
AMPS	X	X	
BILLING DATES		X	X
DATE	X	X	X
DEMAND ACCUM	X	X	
DEMAND INTERVAL	X	X	X
DEMAND LIMIT			X
DEMAND PROJECT	X	X	
ENERGY RATE	X	X	X
INTERVAL SYNC			X
k FACTOR	X	X	X
LOCK			X
PF	X	X	
PRINT HOLD			X
REMOTE FUNCTION (Option 104)			X
SETUP DATA		X	X
STANDBY			X
STATUS		X	X
SUMMARY		X	X
TIME	X	X	X
VA	X	X	
VAR	X	X	
VALUE	X	X	
VOLTS	X	X	
WATTS	X	X	

HOW TO CONNECT THE 808 TO POWER CIRCUITS AND PULSE INITIATING EQUIPMENT

WARNING

Because of shock and fire hazards, connections to this instrument should be performed in compliance with the National Electric Code (ANSI CI) and/or any other requirements which may be applicable to the user. Installation, operation, and maintenance should be performed only by qualified personnel.

General Procedural Suggestions

General sequence of events is suggested as follows:

1. Place the 808 on a flat surface, with the front panel facing you for easy access;
2. Plug the 808 power cord into its source of input voltage (e.g., 120 volts AC), wth the KEYSWITCH in the OFF position;
3. Plug the input connectors of the CT's and voltage cable into the rear of the 808;
4. Hook up the CT's and voltage cable connecting leads appropriately to the ciruit to be monitored;
5. Turn the 808 KEYSWITCH from OFF to the SETUP position, and set up the 808 to perform your desired instructions. (See page 53.)

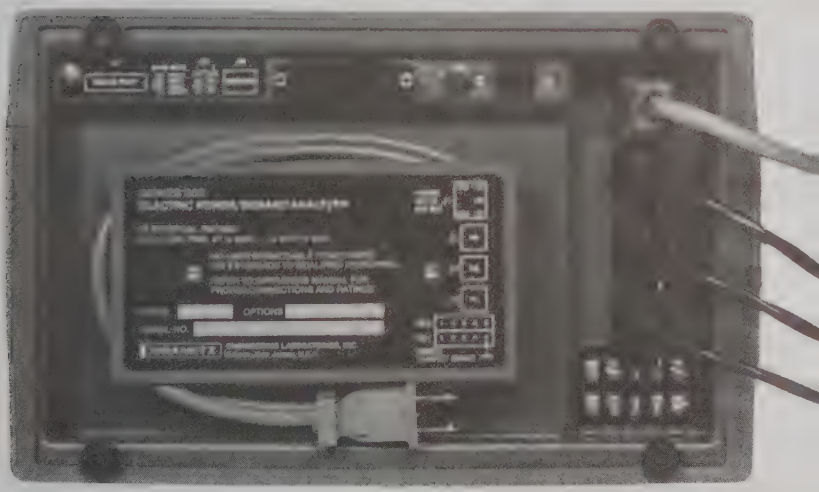


Figure 10. Rear View of the 808.

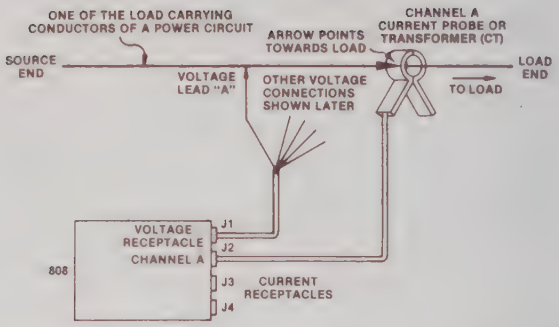


Figure 11. Current and Voltage Inputs for Power Channel "A" Connected to the SAME Load-Carrying Conductor, Current Flow Toward the Load.

THE FOUR BASIC CIRCUIT CONNECTION RULES

Correct power measurement results are obtained when four important rules are followed for connecting the 808 to the load carrying conductors. (See Figure 11.)

RULE 1:

Voltage and current of a single circuit or phase *must* both be measured by *similarly marked* 808 input channels. For example, the "A" voltage sensing lead and the "A" CT or Isolated CT Termination are paired for one channel of power measurement; connect the "A" pair to the same load carrying conductor, as shown in Figure 11. Connect the "B" pair to another conductor and the "C" pair to a third (if there is a need for "B" channel and "C" channel power measurements).

RULE 2:

Input devices have polarity indicators that must be oriented properly. As an example, Dranetz clamp-on probe CT's are marked with an arrow that *must* point toward the load when the CT is clamped around a load-carrying conductor.

Rule 3:

The 808 must be properly set up for the *number of CT's (channels)* to be used for each hook-up. In a polyphase measurement, all voltage and current measurements must be made *in reference to a single point* in the circuit concerned. Remember: the number of 808 measurement channels is always *one less* than the number of current bearing wires in a system!

Current is *not* required to be measured in the voltage reference (neutral) lead, because this current is always the vectorial sum of the other leads (Kirchoff's Law) and is accounted for in the *totals of the power quantities measured and calculated by the 808.*

RULE 4:

All connections to live circuits should be made by authorized personnel.

EQUIPMENT GROUNDING (SAFETY) WIRES

In many modern systems, an additional conductor is installed with the electric load circuit conductors. An example is the bare or green-

insulated conductor used in many wiring installations. The conductor does not carry load current in a healthy circuit; it is connected to ground at the source and to all metal enclosures of the power conductors for safety purposes. An equipment grounding conductor is not supplied in the 808 power cord; it is, however, required to connect the 808 voltage cable green lead as a safety ground.

Separate 808 voltage and current measurements may help in identifying an equipment grounding conductor. Both an equipment grounding conductor and a neutral return conductor for line-to-neutral loads have voltages to ground at or near zero, but the equipment ground (green) wire carries no current in a healthy circuit.

POWER MEASUREMENTS — GENERAL

A current and voltage measurement determine power measurement for each channel of the 808. A channel measures power quantities to the load for the two conductor circuit that determines its inputs: one channel input is the current sensed flowing toward the load in one conductor; the other channel input is the voltage measured from the same conductor to the other conductor which acts as a current "return" path for the power measurement. The typical connection of one current transformer (CT) and one voltage lead in Figure 11 is completed in Figure 12(a) and Figure 12(b) by the connection of the "N" neutral voltage lead and the unused voltage leads to the "return" conductor.

Usually the "N" neutral "return" for 808 measurements is chosen as the wire having a voltage at or near ground (as measured by separate voltage measurement using the 808). An exception is the ungrounded delta circuit.

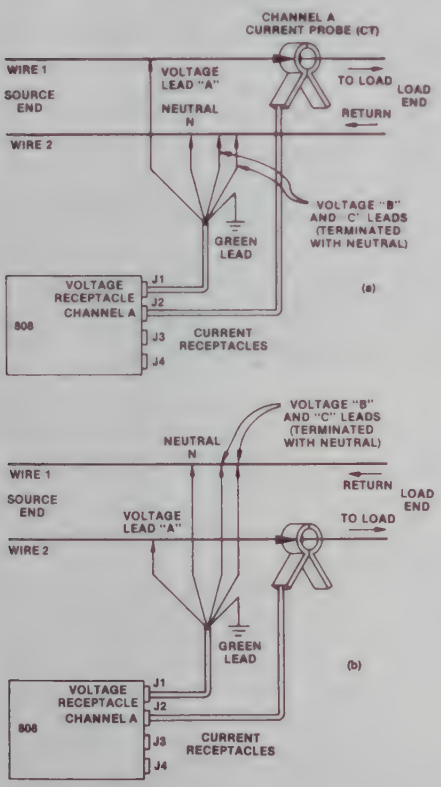


*Figure 12. Connections (either diagram) for 808 Power Measurements, Circuit with Two Conductors to the Load (808 set for **single channel** measurement).*

The five leads in the voltage input cable are leads for channels A, B and C voltage measurements, a neutral N and and equipment grounding lead (green). The green lead should always be connected to a metallic ground such as a water pipe or building steel. All unused channel voltage cable leads should be connected to the same wire as the neutral wire. (The 808 should be set for a single channel measurement in the example of Figure 12.)

The five conductors in the voltage input cable are terminated with tinned leads, in order to be adaptable for all kinds of voltage connection applications.

HOW TO CONNECT THE 808 TO POWER CIRCUITS (UP TO 600 V RMS)

(See page 9 for measurements over 600 V RMS)

Two-Wire Circuits

Connections using only Channel A are made for measuring power in a single-phase, two-wire circuit as shown in Figure 12. Wire 1 is chosen as the conductor with current flowing "to the load" in Figure 12(a). If Wire 2 is chosen instead, as in Figure 12(b), equally correct measurements would result.

The appropriate k Factors must be entered into the 808, which must be set up for a *one channel* measurement.

Three-Wire Circuits

NOTE: The 808 is a *true polyphase wattmeter*. Although individual channel data presented via the two channel method might be confusing to some people, the measurements are *correct* (and not necessarily what one may *think* they should be)!

The 808 does *not assume* a three-phase system — *no assumptions* of any kind are made by the 808 (such as phase angle; in fact, the phase angle between the two channels can be at any angle from 0 to 360 degrees), and the 808 will still provide the *true* total Watts and VARs drawn by the three-wire load!

Power measurements for three-wire circuits use two channels, A and B, of the 808. The 808 should be set for a *two channel* measurement. One of the conductors is chosen for measurement purposes as the "return" for the other two. The "return" is the conductor with voltage to ground at or near zero, determined by separate measurement. If none of the three has voltage to ground at or near zero, any one may be selected as the "return". The Channels A and B current and voltage connections are made as shown in Figure 13, page 33, with Wire 2 chosen as the "return" conductor.

The appropriate k FACTORs must be entered into the 808, which must be set up for a *two channel* measurement.

Single-Phase, Three-Wire Circuits

One common three-wire circuit is the 120/240V single-phase, three-wire circuit often used for residential wiring. In Figure 13, the best choice for the neutral power connection, is the actual grounded neutral of the single-phase, three-wire system. If this choice is made, and all the loads are 120 V loads connected from Wire 1 or Wire 3 to Wire 2 in Figure 13, the 808 Channel A measurements have a direct correspondence to the circuit

loads. That is, Channel A measures power quantities for the 120 V load connected between Wire 1 and Wire 2, and Channel B measures power quantities for the 120 V load connected between Wire 3 and Wire 2.

If a 240 V load is added to the above, connected between Wire 1 and Wire 3, the direct correspondence between individual channel measurements and individual loads is lost. The 240 V load is distributed between Channel A and Channel B. The *total* (sum of A and B) is the correct *total load power*, and related power quantities are correct for the *total load*.

Three-Phase, Three-Wire Circuits

Another common three-wire circuit is the 240 V or 480 V three-phase, three-wire *(delta)* power circuit frequently found in older industrial establishments. Sometimes one phase is intentionally connected to ground; if so, the grounded phase would normally be chosen (by separate voltage measurements) to be the "neutral-return" circuit for 808 power measurement, *but any phase can be selected if none are grounded.* Connections are made as in Figure 13. The *totals* found from the sum of Channel A plus B *power measurements* (W, VA, VAR, PF) are correct for total three-phase load. The 808 should be set for a *two channel* measurement.

A direct correspondence between one of the channel measurements and a particular part of the load (for example, PF of Channel A and load between Wires 1 and 2) would be extremely unusual. Most three-phase loads are balanced, or are nearly so, as though three essentially equal loads are connected — one from Wire 1 to Wire 2, another from Wire 2 to Wire 3 and a third from Wire 3 to Wire 1. The load from Wire 3 to Wire 1 is accounted for partly in each of the Channel A and Channel B measurements, somewhat like the 240 V load is accounted

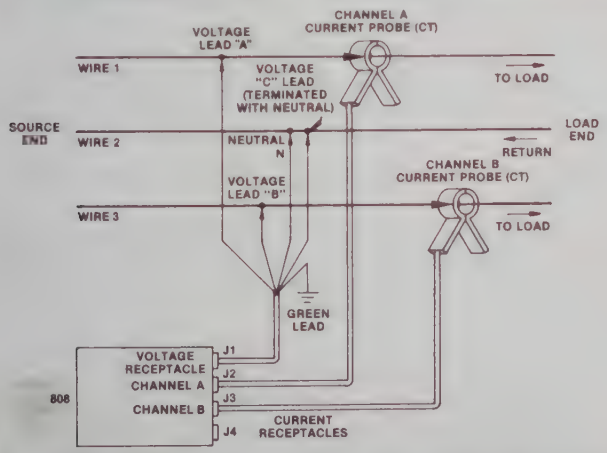


Figure 13.
Connections for 808 Power Measurements, single-phase, or three-phase circuit with three conductors to the load. (808 set for ***two channel*** *measurement.)*

for in both channel measurements in the single-phase, three-wire circuit previously described.

The distribution of the total power between Channel A and Channel B measurements is also influenced by the power factor and the *unbalance* of the three-phase load. See page 37 for the meaning of separate Channel A and B measurements for three-phase, three-wire circuits with balanced loads. Accurate measurements are made on balanced *and* unbalanced loads.

IMPORTANT:
For Three-Phase Systems
(Delta circuits using 2 CT's)

The two channel connection method utilizes *line-to-line* voltages and line currents (2 wattmeter method); *load branch currents* are displaced from each other by an angle. Because of these angular relationships the 808 readouts or printouts of the *individual* channel measurements represent complex vector *components* of the totals for W, VA, VAR and PF (in fact, it is possible that individual channel PF's may be less than 0.5 and even negative). Therefore, the readouts or printouts of the *TOTAL* W, VA, VAR and PF values will be *more useful* to the user.

Of course, the *individual channel V and A* data will remain as relevant as always.

Figure 13 shows hook-up with either Dranetz Clamp-on CT's Model TR-2012 (Max. 300 A RMS), or TR-2013 (Max. 1000 A RMS) for current measurement, and Dranetz five-wire cable for voltage (up to 600 V RMS).

When voltage is *not* measured (voltage and PF assumed) eliminate voltage connections A, B, and NEU (see STEP 3 below).

SETTING UP THE 808 FOR MEASURING THREE-WIRE CIRCUITS

Step 1: Set k FACTORs

Set k FACTOR for voltage (see page 16).

Set k FACTOR for current probes at 1.00 when using TR-2012 for up to 300 A RMS. (The Volt k FACTOR for Amps equals 1 in the 808's default setup.)

Set k FACTOR for current probes at 3.00 when using TR-2013 for up to 1000 A RMS.

For current measurements up to 3000 A RMS, use Dranetz CT TR-2015 with the Dranetz Isolated CT Termination P/N 100,635-G5. Here, set the k FACTOR for the current range used: 1000 A RMS, k = 200; 2000 A RMS, k = 400; or 3000 A RMS, k = 600.

Notes:

1. When *other than* Dranetz CT's are used, use the Dranetz Isolated CT Termination P/N 110,635-G1 for 1 A CT's or P/N 100,635-G5 for 5 A CT's, with combined k FACTOR for the CT and the Termination. See page 42 for wiring instructions.
2. Refer to k FACTOR section for 808 setup and method of calculating a combined k FACTOR, pages 16 and 17.

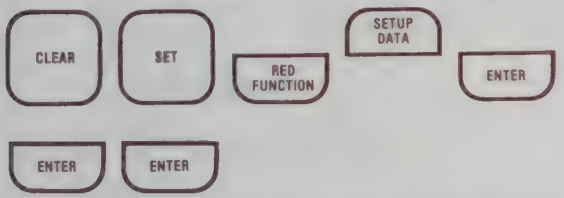
Step 2: Setting Up The 808 For Three-Wire Circuits (2 CT's)

1, 2, or 3 Chan	3

Enter "2" for a two channel (2 CT's) setup, and use CLEAR to cancel the SETUP DATA routine:

Note:
If voltage and current are to be measured, skip STEP 3 and go to STEP 4.

Step 3: Setting Up The 808 For An Assumed Voltage And PF
(Voltage Connections Not Required, as Voltage Will Not be Measured.)



(ENTER must be pressed three times to step the 808 to the next desired display.)

Meas V

OFF/NO

Set V	230.00

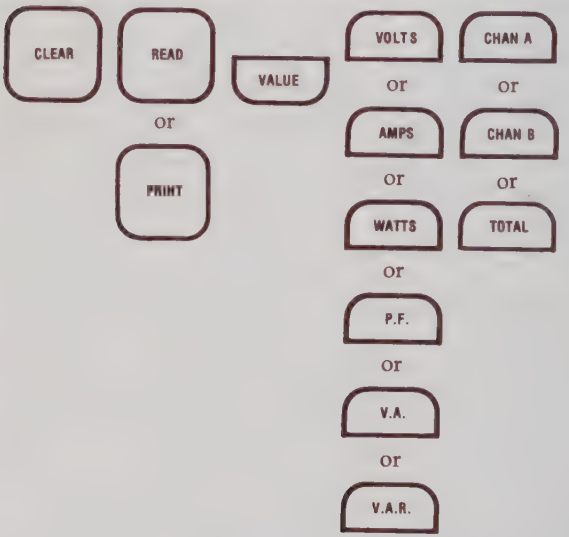
NOTE: Whenever using two CT's on a three-wire, three-phase circuit, you must compensate the assumed voltage for the 30° phase angle of the current. Multiply the line-to-line voltage by 0.866.

EXAMPLE: A three-phase delta circuit has a line-to-line voltage of 230 V. When entering an assumed voltage in the 808, first multiply 230 V by 0.866 and ENTER (0.866 × 230 V = 199.2 V).

Set PF	.99

Example: Set PF to 85% and use CLEAR to cancel the SETUP DATA routine.

Step 4: Key Sequence For Reading And Printing Measurements.



The Meaning Of The Separate Channel A and B Measurements For Three-Phase, Three-Wire Circuits With Balanced Loads.

When the load of a three-phase circuit is balanced, or nearly so, the power readings of separate Channels A and B, connected as in Figure 13 or 18, determine not only the total power but the power factor as well.

The separate power readings to be expected for Channel A and Channel B, *when the load is balanced* and the phase sequence is ABC, are shown in Table III as decimal fractions of the total apparent power (VA) of the three-phase load, at several power factors both lagging (inductive loads) and leading (capacitive loads). It should be noted (see Figure 13 for example) that the voltage of Channel A is a *line-to-line* voltage (between Wires 1 and 2), while the current in Channel A is the sum of currents from Wire 1 to 2 plus that from Wire 1 to 3. Even though for resistive loads, the current from Wire 1 to 2 is in phase with Channel A line-to-line voltage, the current from Wire 1 to 3 is different in phase from the Channel A line-to-line voltage (by 60 degrees). The resultant (or summation) current in Channel A, therefore, is phase shifted by 30 degrees, and results in a phase A power factor reading of 0.866 (leading or lagging, dependent on the connection and ABC or ACB phase rotation), even though the three-phase system has resistive loads. (Channel B has a similar result, except that the phase shift is opposite in sign to that of Channel A.)

Table III, therefore, shows not only the normalized power read in each

Table III. Channel Power Measurements, as a Decimal Fraction of the Total Apparent Power (VA) for ***Balanced*** *Three-Phase Loads of Various Power Factors, ABC Sequence.*

INDUCTIVE LOADS (Lagging PF)					CAPACITIVE LOADS (Leading PF)				
Total power factor	Channel A		Channel B		Total power factor	Channel A		Channel B	
	Power	Power factor	Power	Power factor		Power	Power factor	Power	Power factor
1.0	0.500	+0.866	0.500	+0.866	1.0	0.500	−0.866	0.500	0.866
0.9	0.576	+0.997	0.324	+0.561	−0.9	0.324	−0.561	0.576	0.997
0.8	0.573	0.993	0.227	+0.393	−0.8	0.227	−0.393	0.573	−0.993
0.7	0.556	0.963	0.144	+0.249	−0.7	0.144	−0.249	0.556	−0.963
0.6	0.531	0.920	0.069	+0.120	−0.6	0.069	−0.120	0.531	−0.920
0.5	0.500	0.866	0	0	−0.5	0	0	0.500	−0.866
0.4	0.465	0.805	−0.065	−0.112	−0.4	−0.065	−0.112	0.465	−0.805
0.3	0.425	0.737	−0.125	−0.217	−0.3	−0.125	−0.217	0.425	−0.737
0.2	0.383	0.663	−0.183	−0.317	−0.2	−0.183	−0.317	0.383	−0.663
0.1	0.337	0.584	−0.237	−0.411	−0.1	−0.237	−0.411	0.337	−0.584
0	0.287	0.500	−0.287	−0.500	0	−0.287	−0.500	0.287	−0.500

Notes:

1. Power is expressed as a decimal fraction of the total apparent power (VA).
2. Remember — for identification purposes only, the 808 assigns plus signs to lagging (inductive) power factors and minus signs to leading (capacitive) power factors.

channel for various total power factors, but also shows the individual Channel A and B power factors for *balanced loads* having total leading as well as lagging power factors. Furthermore, note that one measurement is expected to be negative for power factors less than 0.50.

Again it should be noted that the above applies to *balanced* three-phase, three-wire systems with *balanced loads*. The situation can be more complex, of course, with unbalanced loads.

In the past, the total power factor of such a system (for balanced loads) has been determined from the ratio of the smaller to the larger of the separate channel power measurements shown in Table III. The 808, however, with its advanced microprocessor capability, *automatically calculates* the three-phase power. Additionally, the 808 calculates the power and power factor under unbalanced conditions as well, which might otherwise be difficult to compute.* Of course, for simple cases of *balanced* circuits, this chart and the readings of the Model 808 should be in agreement.

How To Connect The 808 To Four-Wire Power Circuits (Up to 600 V RMS)

(See page 9 for measurements above 600 V RMS.)

Power measurements for four-wire circuits use all three channels of the 808; the 808 should therefore be set for *a three channel* measurement. One of the four conductors is chosen as the "neutral-return" for the other three. Usually the chosen "return" is the one with voltage at or near ground potential (as determined by separate measurement). Channels A, B and C current and voltage connections are made as shown in Figure 14 with Wire 4 chosen as the "return" conductor.

One common four-wire circuit is the 277/480V three-phase, four-wire circuit used often in industrial and large commercial buildings. (Another is the 120/208V circuit.) The 277V (120V) circuits from the three lines to the grounded neutral are used for lighting, and the 480V (208V) line-to-line, three-phase circuits are used for motors.

The best choice for Wire 4 of Figure 14, the neutral for 808 measurements, is the actual grounded neutral of the four-wire system. If this choice is made, if all single-phase loads are connected *line-to-neutral* and if all three-phase loads are *balanced*, the individual channel measurements have direct (though not simple) correspondence to individual circuit loads. Channel A measures power quantities for the 277V (120V) load connected between Wire 1 and Wire 4 *plus* one third of the total balanced three-phase load. Channels B and C make similar measurements for Wire 2 and Wire 3 single-phase loads *plus* each includes one third of the balanced three-phase load.

If there are any 480V (or 208V) single-phase loads connected line-to-line that *unbalance* the three-phase load, the direct correspondence between channel measurements and individual loads is lost. The *total power* of the three channels is, however, the correct total load power, and the related *total power*

* *The 808 accomplishes this by summing channel KW's and VAR's, making a vectorial calculation of total VA, then dividing KW by total VA to compute PF. This procedure is correct with unbalanced as well as balanced circuits.*

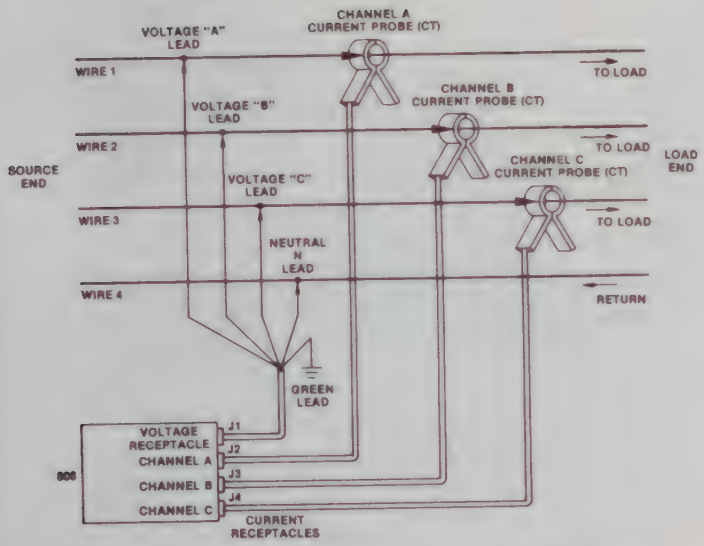


Figure 14. Connections for 808 Power Measurements, Circuit with Four Conductors to the Load (808 set for ***three channel*** *measurement).*

quantities are also correct for the *total load.*

Figure 14 shows a hook-up with Dranetz Clamp-on CT's Models TR-2012 (Max. 300 A RMS) or TR-2013 (Max. 1000 A RMS) for current connections, and the Dranetz five wire cable for voltage (up to 600 V RMS).

When voltage is *not* measured (voltage and PF assumed), eliminate voltage connections A, B, C and NEU. (See Step 3 below.)

Note:
When using an assumed voltage with four-wire circuits, use *line-to-neutral* voltages.

SETTING UP THE 808 FOR MEASURING FOUR-WIRE CIRCUITS

Step 1: Set k FACTORs

Set k FACTOR for voltage (see page 16).

Set k FACTOR for current probes at 1.00 when using TR-2012 for up to 300 A RMS (default setup).

Set k FACTOR for current probes at 3.00 when using TR-2013 for up to 1000 A RMS.

For current measurements up to 3000 A RMS, use Dranetz CT TR-2015 with the Dranetz Isolated CT Termination P/N 110,635-G5. Then, set the k FACTOR for the current range used: 1000 A RMS, k = 200; 2000 A RMS, k = 400; or 3000 A RMS, k = 600.

Notes:

1. When *other than Dranetz* CT's are used, use the Dranetz Isolated CT Termination P/N 110,635-G1 for 1 A CT's or P/N 110,635-G5 for 5 A CT's, with combined k FACTOR for the CT and the Termination. (See page 42 for wiring instructions.)
2. Refer to k FACTOR pages 16 and 17 for 808 setup and method of calculating a combined k FACTOR.

Step 2: Setting Up The 808 For Four-Wire Circuits (3 CT's)

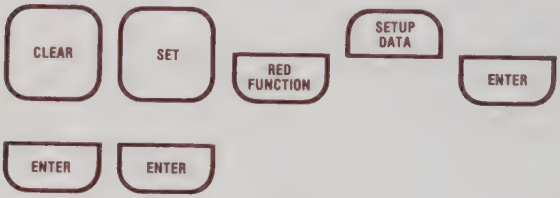
Start with KEYSWITCH in OFF position, and then turn to SETUP position. (The default setup is three channels, and both current and voltage will be measured.) Or, use SETUP DATA routine on page 53 and program 808 for three channels and voltage measurement.

Note:

Skip to STEP 4 if both voltage and current will be measured.

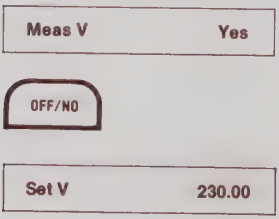
Step 3: Setting Up The 808 For An Assumed Voltage And PF

(Voltage Connections Not Required, as Voltage Will Not be Measured.)



(ENTER must be pressed three times to index proper display.)

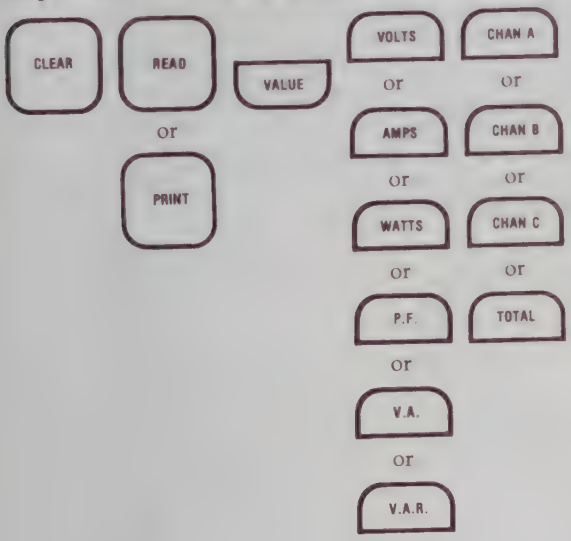
Display will then read:



Example: To change from 230 V to an assumed voltage of 115 V line-to-neutral, set assumed voltage to 115 V and press ENTER:

Example: Set PF to 85% and CLEAR:

Step 4: Key Sequence For Reading And Printing Measurements.



INPUT CONNECTIONS TO THE 808

Dranetz Isolated CT Terminations

For low voltage circuits with currents less than 10 A, a Dranetz Isolated CT Termination (P/N 110,635-G5 or P/N 110,635-G1) is inserted into a circuit conductor and its cable connector plugged into the 808. The correct connection polarity is shown in Figure 15(a).

For higher current circuits, CT's (current transformers) are used in the primary circuit (or around the primary conductors, if clamp-on type). Isolated CT Terminations must be used with all CT's except Dranetz TR-2012 and TR-2013 clamp-on current transformers. Refer to Figure 15(b) and (c).

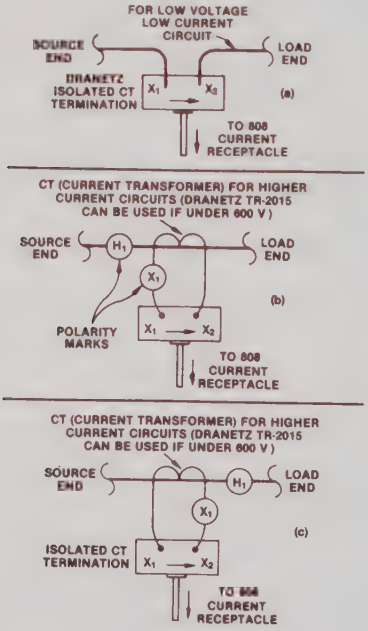


Figure 15. (a, b, c) — Using Dranetz Isolated CT Termination

Current Transformers (CT's)

Using Dranetz CT's (Clamp-on Current Transformer, e.g., TR-2012 or TR-2013.)

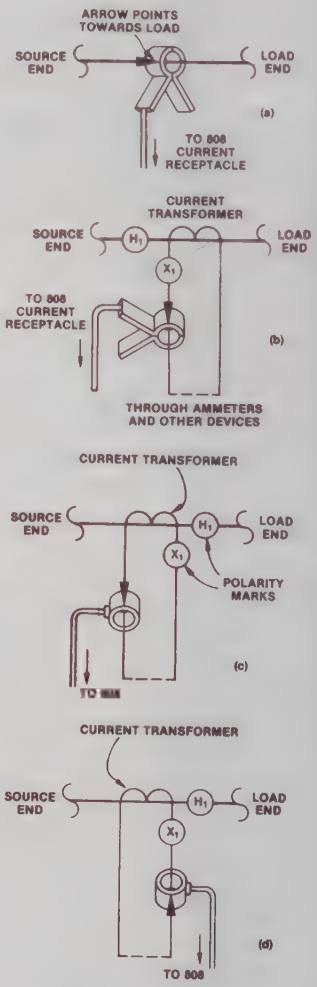


Figure 16. Examples of Current Sensing Connections With Proper Direction of Current Flow (Toward Load) for 808 Power Measurements.

The proper polarization for 808 power measurements makes use of the "polarity marks" that all CT's have (labels H1 and X1 or dots painted near one primary and one secondary terminal). Examples of properly polarized connections are shown in Figures 15(b), (c). *NOTE: CT secondaries should never be open with the primary carrying current.*

The Dranetz Clamp-on CT, Figure 16(a), can also be clamped on the secondary circuits of existing CT's without the need to open any existing wiring. The CT polarity marks again are the key to proper polarization for 808 measurements. Connection examples are Figures 16(b), (c) and (d).

Whenever CT's are used, the CT ratio is keyed into the 808 as a current ratio or k FACTOR to provide proper scaling.

Potential Transformers (PT's)

Direct voltage connections for 808 measurements are normal (k FACTOR for voltage = 1 in this case), in Figure 17(c), for circuit voltages *up to 600 V*. PT's may be used instead, and *must* where circuit voltage is over 600 V RMS. With PT's, the proper polarization for voltages used in 808 power measurements makes use of the "polarity marks" that all PT's have (labels H1 and X1 or dots painted near one primary and one secondary terminal). Examples of proper connections are shown in Figure 17(a) and (b).

CAUTION

These connections require de-energizing the power circuit and opening the conductors to insert the Dranetz Isolated CT Termination. ***CAUTION for CT's:*** *NEVER energize a CT with the secondary open or open the secondary of an energized CT.*

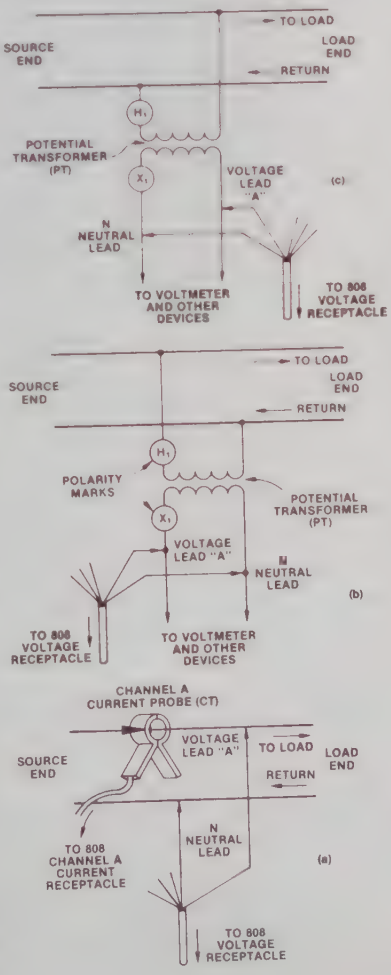


Figure 17. Examples of Voltage Connections With Proper Polarity for 808 Power Measurements.

Using Both CT's and PT's

Whenver PT's are used, the PT ratio is keyed as a voltage ratio (or k FACTOR) into the 808 to provide proper scaling.

An example of the complete 808 connections for a three-phase, three-wire circuit having existing CT's and PT's is shown in Figure 18:

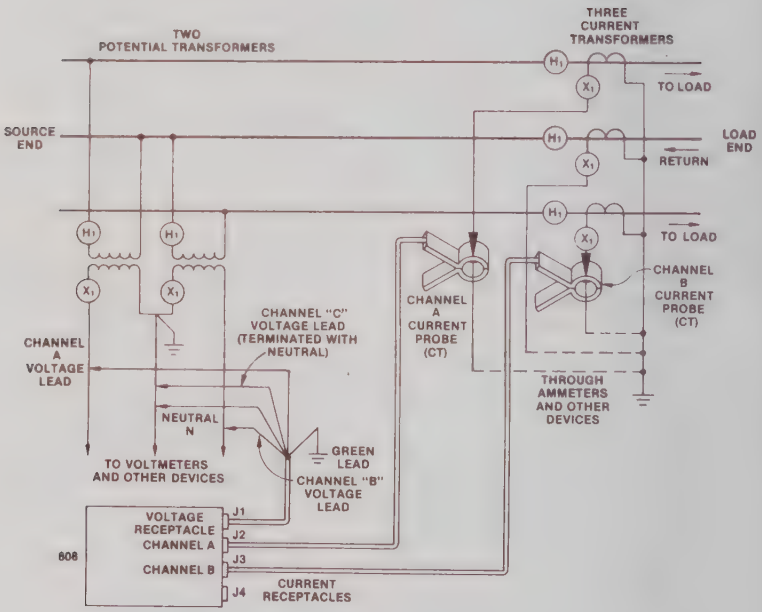


Figure 18. Connections of 808 to Three-Phase, Three-Wire Circuit with Existing PT's and CT's. Current is Sensed with Clamp-on Probes on CT Secondaries.

Using Pulse Inputs To Monitor Demand And Energy

In this situation, the initiator pulses are derived from a revenue meter through a suitable isolating network as required by the utility. Each pulse represents a discrete amount of energy that has been consumed. A multiplying factor in watthours per pulse must be set into the 808 to permit proper interpretation of pulse value.

The external synchronizing pulse is used to synchronize the 808 demand interval with the utility demand interval when the utility makes such a pulse available. Limits can be set on the rate of energy consumption and demand, and the optional alarm contacts close when these limits are exceeded (the 808's own audible alarm can be set up if desired).

Setting Up The 808 for Pulse Input Operations

With pulse inputs, no power circuit connections are to be made. Connect pulse output from the external pulse initiator device to screw terminal block TB2 on the rear panel of the 808. (See Figure 19, page 47.)

Then,

Pulse Mode	No

enables Pulse Mode

WH/Pulse	1.0000

Sets up meter pulse value in Watthours/Pulse (in this case, 1 WH/pulse).

Extrn Sync	No

Now, select A or B below:

A. If an external demand interval synchronization pulse is available, push:

NOTE: Make sure Demand Interval is set to equal length of external synchronization period.

Dm W, VA, or VAR	W

Select WATTS, the only valid setup in pulse mode.

Exit setup routine by pressing CLEAR, or continue with Dm Lim(kW), %Limit Print, and Rt Lim(kW) as desired. (Incld Status must be "No" for this pulse mode setup, see Figure 21, page 53.)

B. If an external sync pulse is *not* used, push:

Set desired demand interval (mins.)

Intv Mins	15

See page 15 for setting a demand interval in minutes.

Sliding	No

Now, select a sliding type demand interval,

or a fixed interval,

"Stop on loss" display will appear, followed by:

Dm W, VA or VAR	W

Select WATTS, the only valid setup in pulse mode.

NOTE:

See INTERVAL SYNC, page 19, for synchronizing the internal 808 timing of the demand interval with the pulse initiator of the demand meter.

Finally, EXIT the SETUP DATA routine by pressing CLEAR, or continue with Dm Lim(kW), %Limit Print and Rt Lim(kW) as desired. (Incld Status must be "No" for this pulse mode setup, see Figure 21, page 53.)

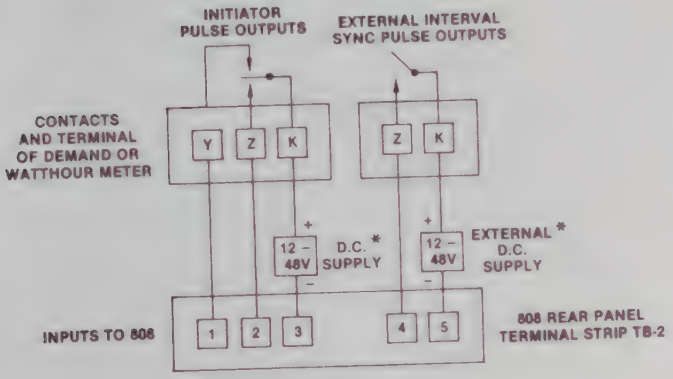


Figure 19(a)

STANDARD (PREFERRED) METHOD

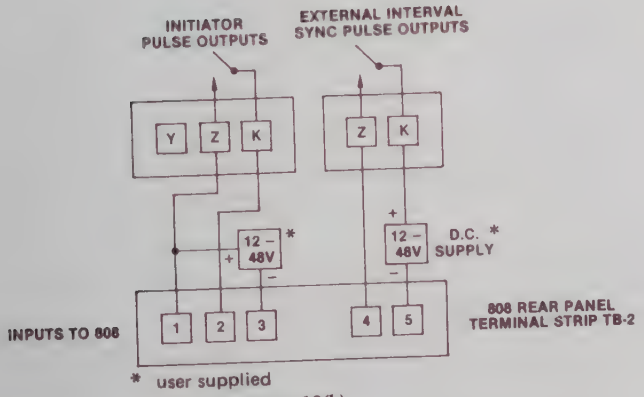


Figure 19(b)

ALTERNATE TWO-WIRE METHOD

Not recommended, unless mercury wetted relays are used.

Connecting The 808 To The Alarm Relays (Option 101)

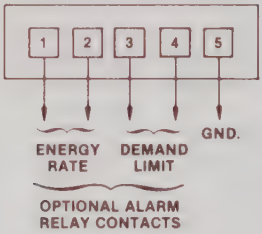


Figure 20. 808 Rear Panel Terminal Strip TB-1.

WHAT TYPE OF CIRCUIT DO I HAVE?

When undertaking power system analysis, it is common to not know exactly what type of circuit you have. In a typical junction box you may see three, four, or five conductors without any kind of conductor identification.

Tables IV and V, together with some simple tests, were created to help you out with this circuit identification problem. For seven different three-wire systems and four different four-wire systems, these tables give line-to-ground voltages, line-to-line voltages, relative current levels in the different conductors, a simple circuit diagram, and instructions on how to connect the 808. Voltage values are given for the common voltage levels at which the particular circuits are used, and the tables also include voltage and current vector diagrams for the various circuits.

The first step is to check for conductors at or near ground potential, using the 808 as a voltmeter. In many modern systems an additional equipment ground conductor is installed with the electric load circuit conductors. An example is the bare, or green insulated conductor used in many wiring installations. The conductor does not carry load current in a healthy circuit, but is connected to ground at the source and to all metal enclosures of the power conductors for safety purposes.

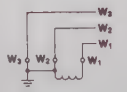
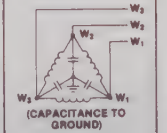
The problem here is that there will probably also be a neutral return conductor for line-to-neutral loads which is also at or near ground potential. An example is the single-phase, three-wire and ground circuit of Table V, where both Wires 3 and 4 are at or near ground potential. Separate 808 voltage to ground and current measurements on Wires 3 and 4 will identify Wire 4 as the equipment ground since normally it should carry no current. Once identified, and while equipment ground is not necessary for 808 measurements, (note Wire 4 is not used in the 808 connection instructions for this circuit), it is a good place to ground the 808 voltage cable green safety ground lead.

Once the current-carrying conductors have been identified, then usually line-to-ground and line-to-line voltage measurements using the 808 will permit identifying the specific circuit type.

Note from Table V that it is impossible to differentiate between a three-phase, three-wire floating delta and a three-phase, three-wire wye without neutral by making voltage and current measurements on the conductors. But it doesn't matter since the 808 is hooked up exactly the same in either case.

In general, it really doesn't matter whether you have precisely identified the circuit type or not, *as long as you follow the simple rules given on pages 29—48, you will get the proper results.*

Table IV — Three-wire systems

Type of System		Single-phase two-wire and ground		Single-phase three-wire		Two-phase three-wire		Three-phase delta one leg grounded		Three-phase delta, floating (near ground)		Three-phase wye without neutral		Three-phase open delta
Measurements to determine system type														
Voltage Line-to-ground	W_1 to ground	120	240	120	240	120	240	240	480	≈138	≈277	≈138	≈277	240
	W_2 to ground	≈0	≈0	120	240	120	240	240	480	≈138	≈277	≈138	≈277	240
	W_3 to ground	0	0	≈0	≈0	≈0	≈0	≈0	≈0	≈138	≈277	≈138	≈277	≈0
Voltage Line-to-line	W_1 to W_2	120	240	240	480	170	340	≈240	≈480	240	480	240	480	≈240
	W_1 to W_3	120	240	120	240	120	240	240	240	240	480	240	480	240
	W_2 to W_3	≈0	≈0	120	240	120	240	240	240	240	480	240	480	240
Current	I_1	I_1		I_1		I_1		I_1		I_1		I_1		I_1
	I_2	$I_1 = I_2$		I_2		$I_2 \approx I_1$		$I_2 \approx I_1$		$I_2 \approx I_1$		$I_2 \approx I_1$		$I_2 \approx I_1$
	I_3	0		$I_3 \approx I_1 - I_2$		$I_3 = 1.4 \times I_1$		$I_3 \approx I_1$		$I_3 \approx I_1$		$I_3 \approx I_1$		$I_3 \approx I_1$
System Diagrams														

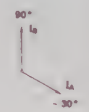
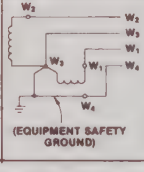
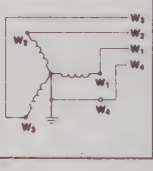
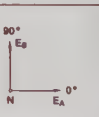
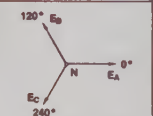
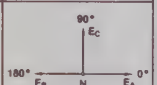
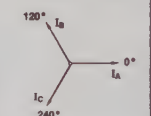
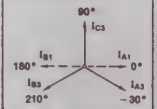
808 measurement type	How to connect the 808						
	One-channel	Two-channel	Two-channel	Two-channel	Two-channel	Two-channel	Two-channel
Voltage lead connections	A to W_1 B to W_2 C to W_2 N to W_2 G to ground	A to W_1 B to W_2 C to W_3 N to W_3 G to ground	A to W_1 B to W_2 C to W_3 N to W_3 G to ground	A to W_1 B to W_2 C to W_3 N to W_3 G to ground	A to W_1 B to W_2 C to W_3 N to W_3 G to ground	A to W_1 B to W_2 C to W_3 N to W_3 G to ground	A to W_1 B to W_2 C to W_3 N to W_3 G to ground
CT or current probe connections (arrow or X_2 towards load)	A on W_1 B not used C not used	A on W_1 B on W_2 C not used	A to W_1 B on W_2 C not used	A to W_1 B on W_2 C not used	A on W_1 B on W_2 C not used	A on W_1 B on W_2 C not used	A on W_1 B on W_3 C not used
Voltage vector representation							
Current vector representation (with resistive loads)							

Table V — Four-wire systems

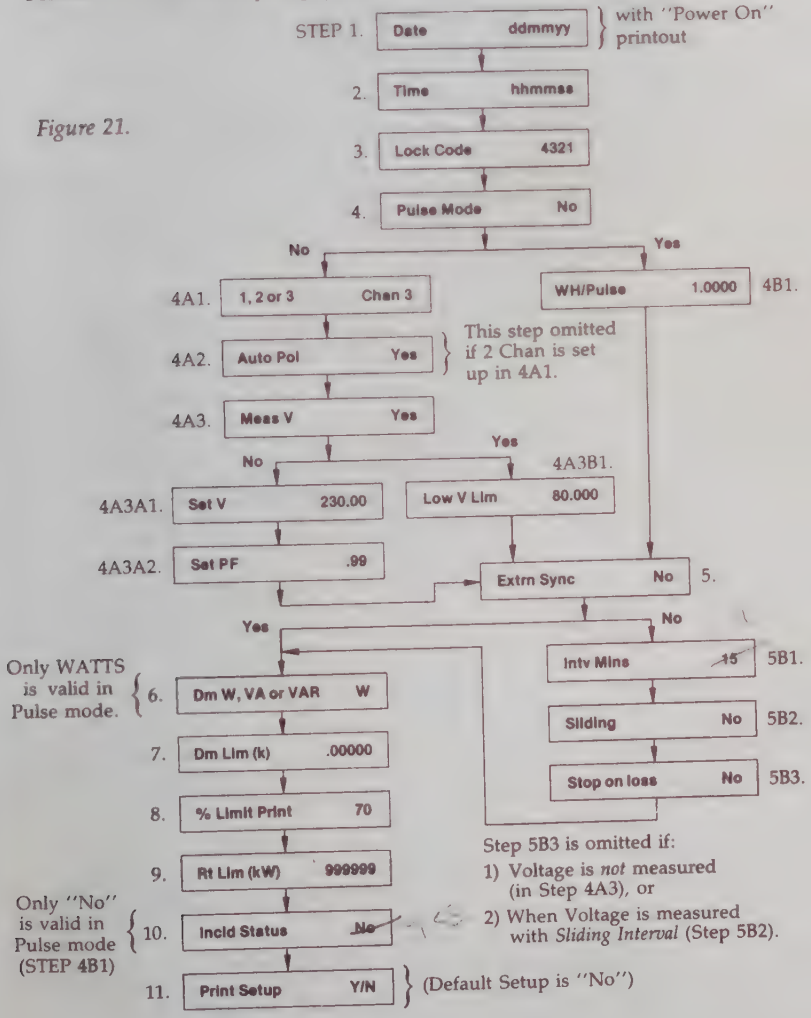
Type of System		Single-phase, three-wire, and ground		Two-phase, three-wire, and ground		Three-phase, four-wire wye			Three-phase delta with center tap (red-legged)	
Measurements to determine system type										
Voltage	Line-to-gnd	W_1 to gnd	120	240	120	240	120	240	277	120	240
		W_2 to gnd	120	240	120	240	120	240	277	120	240
		W_3 to gnd	≈0	≈0	≈0	≈0	120	240	277	208	416
		W_4 to gnd	0	0	0	0	≈0	≈0	≈0	≈0	≈0
	Line-to-line	W_1 to W_2	240	480	170	340	208	416	480	240	480
		W_1 to W_3	120	240	120	240	208	416	480	240	480
		W_1 to W_4	120	240	120	240	120	240	277	120	240
		W_2 to W_3	120	240	120	240	208	416	480	240	480
		W_2 to W_4	120	240	120	240	120	240	277	120	240
		W_3 to W_4	≈0	≈0	≈0	≈0	120	240	277	208	416
Current	I_1	I_1			I_1		I_1			Load dependent	
	I_2	I_2			$I_2 \approx I_1$		$I_2 \approx I_1$				
	I_3	$I_3 = I_1 - I_2$			$I_3 \approx 1.4 \times I_1$		$I_3 \approx I_1$				
	I_4	0			0		0				
System configurations		(EQUIPMENT SAFETY GROUND)		 (EQUIPMENT SAFETY GROUND)						
How to connect the 808										
808 Measurement Type		**Two-channel**		**Two-channel**		**Three-channel**			**Three-channel**	
Voltage lead connections		A to W_1 B to W_2 C to W_3 N to W_3 G to ground		A to W_1 B to W_2 C to W_3 N to W_3 G to ground		A to W_1 B to W_2 C to W_3 N to W_4 G to ground			A to W_1 B to W_2 C to W_3 N to W_4 G to ground	
CT or current probe connections (arrow or X_2 towards load)		A on W_1 B on W_2 C not used		A on W_1 B on W_2 C not used		A on W_1 B on W_2 C on W_3			A on W_1 B on W_2 C on W_3	
Voltage vector representation										
Current vector representation (with resistive loads)									 [Depends on combination of three-phase (subscript 3) and single-phase (subscript 1) loads]	

USER PROMPTED INSTRUCTIONS TO THE 808 VIA THE SETUP DATA KEY

After the "Power On" printout which results when the KEY-SWITCH is moved from OFF to OPER or SETUP, the 808 displays STEP 1 (Figure 21) of this prompted setup routine. The information to the right in each display is the default or preset setup for that step.

All Displays Show Default Setups Following the "Power On" Printout. To Exit at any step, push CLEAR.

Figure 21.

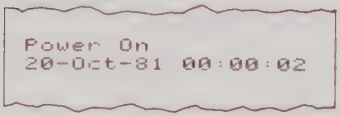

STEP 1. Date ddmmyy } with "Power On" printout
2. Time hhmmss
3. Lock Code 4321
4. Pulse Mode No
No
Yes
4A1. 1, 2 or 3 Chan 3
WH/Pulse 1.0000 4B1.
4A2. Auto Pol Yes
This step omitted if 2 Chan is set up in 4A1.
4A3. Meas V Yes
Yes
No
4A3B1.
4A3A1. Set V 230.00
Low V Lim 80.000
4A3A2. Set PF .99
Extrn Sync No 5.
Yes
No
Only WATTS is valid in Pulse mode.
6. Dm W, VA or VAR W
Intv Mins 15 5B1.
Sliding No 5B2.
7. Dm Lim (k) .00000
Stop on loss No 5B3.
8. % Limit Print 70
9. Rt Lim (kW) 999999
Step 5B3 is omitted if:
1) Voltage is not measured (in Step 4A3), or
2) When Voltage is measured with Sliding Interval (Step 5B2).
Only "No" is valid in Pulse mode (STEP 4B1)
10. Incld Status No
11. Print Setup Y/N } (Default Setup is "No")

By simply answering each display with

or the desired numerical data, the user will be led through various setup choices. The user may also select SETUP DATA by using the green SET Mode key. The first step by this method becomes STEP 3 in Figure 21.

Use other setups for BILLING DATES, STATUS, and SUMMARY by selecting them from the keypad using the green SET key.

Now, the sequence of steps, one-by-one:



Example of "Power On" Printout

STEP 1.

Date	ddmmyy

Enter day, month and year.

Example: 1 June 1983

NOTE: To change a setup after partially or fully completing the SETUP DATA routine, simply start over at STEP 1 and use ENTER to index through the steps to reach the step to be changed, and make the change within 30 seconds. Use CLEAR to exit from the routine at any time.

STEP 2.

Time	hhmmss

Enter time of day in hours, minutes, and seconds, using a 24-hour clock system

Example: 2:05:04 PM

STEP 3.

Lock Code	4321

Use ENTER to accept. To set other code, select any four digits and ENTER.

Example: Change LOCK code to 3681.

STEP 4. | Pulse Mode | No |

The routine branches here (see Figure 21) between pulse input only and analog measurements. Push:

If Pulse Mode will *not* be used.

STEP 4A1. | 1, 2, or 3 Chan | 3 |

(if "No" in STEP 4)
(Next step is STEP 4A2)

Enter desired number of channels.

STEP 4B1. | WH/Pulse | 1.0000 |

(if "Yes" in STEP 4)

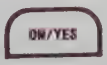
Enter watthours/pulse per page 45 (next step is STEP 5) and push:

STEP 4A2. | Auto Pol | Yes |

When used, eliminates need for orienting polarity markings on CT's toward load. Positive CT polarity will be answered regardless of CT orientation on the conductor, unless indicated otherwise by answering "No" to this instruction. *Used only with one and three channel setups.* This step is omitted in the sequence if 2 CHAN is set in STEP 4A1. Push:

for a one or three channel setup if desired.

STEP 4A3. | Meas V | Yes |



if voltage will be measured.

or

if an assumed voltage value will be entered.

STEP 4A3B1. (if "Yes" in STEP 4A3)

Low V Lim	80.000

STEP 4A3A1. (if "No" in STEP 4A3)

Set V	230.00

STEP 4A3A2. (if "No" in STEP 4A3)

Set PF	.99

Enter desired numerical values and push:

ENTER

STEP 5.

Extrn Sync	No

Means external synchronization of demand intervals is disabled and sync will be performed internally by the 808. If a sync pulse from a pulse initiating device *is* available, push: ON/YES and proceed directly to STEP 6.

Otherwise, push:

OFF/NO and follow STEPS 5B1, 5B2, and 5B3.

STEP 5B1.

Intv Mins	15

then push ENTER

Enter demand interval of local utility. (See DEMAND INTERVAL, page 15.) Please realize that on some original 808 software revisions, the smallest fixed demand interval is *five* minutes.

STEP 5B2.

Sliding	No

Enter OFF/NO if fixed,

or

ON/YES if sliding interval.

STEP 5B3.

Stop on loss	No

Means 808 interval timing will not stop whenever voltage on *all* channels falls below voltage value set in STEP 4A3B1 (for example, in the case of a power outage). This step is omitted if voltage is *not* measured (STEP 4A3) or if sliding interval is measured in STEP 5B2.

STEP 6

Dm W, VA or VAR	W

Select the type of demand your utility uses. Refer to their billing schedule, use appropriate UNIT key (must be set to W for Pulse mode using pulse initiating device) then push:

ENTER

STEP 7

Dm Lim(k)	.00000

Default setup of "zero" produces a demand printout at the end of each demand interval (See page 14). STATUS printout may be included in the demand printout. (Refer to STEP 10.) Set limit at value above which printout (and ALARM see page 13) is desired. Enter numerical value and push:

ENTER

STEP 8

% Limit Print	70

Prints all demands at 70% or more of the Dm Lim setting of STEP 7 in 10% increments from 0-100%. For example: Set Dm Lim(k) at 450 (STEP 7). Printout shows measured demand of 355.0 KW is between 80% and 90% of the Dm Lim(k) setting (81%), on May 8, 1982 at 3:34 (and 53 seconds) A.M.:

Example printout:

```
8Dm 355.0KW      .99PF
 08-May-82  03:34:53
```

NOTE:
If symbol # instead of a number 1-9 precedes Dm it would indicate the measured demand was greater than 100% of the setting of Dm Lim(k) (STEP 7).

STEP 9.

Rt Lim (kW)	999999

Use to set ENERGY RATE above which printout is to occur and/or ALARM is to operate. See page 13.

STEP 10.

Incld Status	No

If STATUS printout is to follow all printouts of excess demand, press:

(See page 23 for content of STATUS printout.)

See paragraph 2 on page 59, if periodic STATUS reports are desired, regardless of demand.

NOTE:
In Pulse Mode setup (STEP 4), only "No" is valid for STEP 10.

STEP 11.

Print Setup	Y/N

(Default Setup is "No")

Now press:

for a *complete printout of the setup* you have just completed beginning with STEP 1.

THE HELPFUL "HOW TO" SECTION

1. **To Set Up the 808 to Automatically Print KWH:**
   Set three specific SUMMARY print times as desired, page 25.
   Or, set DEMAND LIMIT (Watts) to zero and DEMAND INTERVAL to 60 minutes; KW at the end of such an interval equals KWH.
   Or, if more frequent KWH printouts are required, say every five minutes, set DEMAND INTERVAL to 5 minutes instead; KW at the end of such an interval when divided by 12 (5 × 12 = 60 minutes) equals KWH.

2. **For Periodic V, A, W, VA, VAR or PF Quantity Printouts:**
   SET the DEMAND INTERVAL in minutes to the desired frequency of your STATUS printouts, and set DEMAND LIMIT to zero. SET the STATUS for the specific quantities to be printed, and use SETUP DATA to include a STATUS printout (STEP 10 of Figure 21, pg. 58) after each excess DEMAND LIMIT printout.

3. **To Print STATUS and SUMMARY at the Same Time:**
   Set desired SUMMARY print times. Then key ON/YES in response to Incld Status Y/N display.

4. **To Charge 808 Battery:**
   When unit will not optimally function due to low battery, or it is desired to have a fully charged battery, plug in the 808 and set KEYSWITCH to OFF for 12-15 hours.
   If the "Charger<Lim" printout or display occurs (the 808 will sound audible beeps about every eight seconds as well), this indicates that the 808 detects a loss of input power to itself; check to be sure that the input power cord is plugged in. Unless input power is restored, the 808 will continue to run strictly on the present strength of its own internal battery for about 15 minutes, and then place itself into Standby mode.

5. **To Change Only One Setup Step of the SETUP DATA Routine:**
   Select SETUP DATA per page 15 and use ENTER to step through sequence per pages 53—58 to desired step and make complete change required. (Try to make the change within 30 seconds, as the 808 display will revert back to its previous display after this period of time.) Then push CLEAR in order to exit from the routine.
   To *confirm or look over* a Setup, use ENTER to step through the entire routine, or obtain a printout by pressing CLEAR, PRINT, RED FUNCTION, and SETUP DATA.

6. **To Measure Voltages Over 600 V or Currents Over 3000 A:**
   Use PT's and CT's specially noted for the application. CT's require Dranetz Isolated CT Terminations for connection to the 808.

7. **To Use the 808 on More Than One Three-Phase Power Circuit at the Same Time:**
   Not recommended.

8. **To Totalize or Sum 808 Demand and Energy Data From Two or More 808's:**
Use Dranetz Communications Option 104 and process the 808's digital data output with a computer.

9. **To Output the 808 Data to Print or Display on Another Device:** Use Dranetz Communications Option 106 RS-232C output for up to 100 feet (ASCII), or BELL 103 Compatible Modem for output for greater distances.

10. **To Connect 808 to a Power Circuit I Know is a Three-Phase, 4-Wire WYE, But the Neutral is Not Available:**
Connect as a Three-phase, 3-wire circuit (2 CT's). The 808 will provide correct data!

11. **To Understand a Negative Power Factor:**
A negative PF that is displayed or printed out by the 808 is a Dranetz convention characteristic of circuits with leading current, such as capacitive loads. It does *not* indicate that the load is dissipating "negative power".

    A positive PF is indicative of circuits with lagging current, such as inductive loads.

12. **To Measure a Reverse Power Flow if Anticipated or Desired to be Measured:**
For one or three channel setups, answer OFF/NO to Auto Pol in the 808's setup routine.

    Negative watts is, in fact, an indication of a reverse power flow, providing the 808 hook-up is made *correctly* (including direction of CT's and similarly marked pairs of individual input channel connections for a load carrying conductor.)

13. **To Measure Power When There are Multiple Conductors Per Phase:**
If a phase is composed of several multiple conductors, the bundle may be too large to fit into a clamp-on CT. Measure individual currents in each multiple conductor (ideally using a constant load). If the currents are virtually equal, consider the *number* of multiple conductors *equal to the k FACTOR* for Amps (or a component of a combined k FACTOR for Amps if appropriate — see page 17 for discussion of combined k FACTOR).

    If these individual currents differ substantially from each other, add these currents together to form a *total*. Pick any multiple conductor to take your power measurements, and divide the *total* by this conductor's current. Use the resulting number as the k FACTOR for Amps (or a component of a combined k FACTOR if appropriate — see page 17).

    Please be advised that if your individual multiple conductors vary widely in current readings, you should check the quality of the connections at the ends of those conductors which are severely unbalanced!

14. **To Learn More or Refresh your Memory about Electrical Power Theory and Measurement:**
Unless you have already done so, attend a Dranetz Seminar. See your local sales representative for details.

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